LYRIELASMA AND A NEW RELATED GENUS OF DEVONIAN TETRACORALS

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Abstract

The type species of *Lyrielasma* and six related species from the Lower Devonian of SE. Australia are described and figured. Subspecies are recognized in three of these and a variety in another. The generic concept of *Lyrielasma* is conserved by referring to it only species having a peripheral stereozone containing an appreciable amount of lamellar sclerenchyme. Similar fasciculate species lacking such a stereozone are placed in a new genus *Embolophyllum*. As originally named the type species of *Lyrielasma* was a junior primary homonym; a new name therefore is proposed for it. Systematically treated taxa are: *Lyrielasma chapmani chapmani* nom. nov., *L. chapmani praecursor* Philip, *L.* sp. nov., cf. *L. chapmani* nom. nov., *Embolophyllum asper* (Hill), *E. aggregatum aggregatum* (Hill), *E. aggregatum cracente* subsp. nov., *E. aequiseptatum aequiseptatum* (Hill), *E. aequiseptatum buchanense* subsp. nov., *E. mundum* sp. nov., *E.* (?) *mausfieldense* (Dun), *E.* (?) *mansfieldense* var. *fecundum* nov.

Introduction

The type species of *Acanthophyllum* and *Grypophyllum* have been redescribed in recent years. However, apart from the erection of a new subspecies, the type species of the closely related genus *Lyrielasma*, has received only scant attention.

Presentation of a new description and figures of this species, based on abundant topotypes now available, is one of the objects of the present paper, but the main purpose is to demonstrate that certain Australian species, previously supposed to be solitary and placed in *Acanthophyllum*, are in fact fasciculate and generically identical with other species referred to *Lyrielasma* or *Grypophyllum*. For various reasons these species cannot be placed in any of these, or indeed, other described genera, and therefore a new genus, named *Embolophyllum*, is proposed for their reception.

Localities providing the corals described are shown in Fig. 1. While the stratigraphical nomenclature employed for the Victorian sequences is entirely conventional, the nomenclature used for the Wee Jasper area is new, at least as far as the particular area is concerned. A detailed biostratigraphical account of the Wee Jasper area is in preparation and will show an overall similarity between the Taemas-Cavan and Wee Jasper limestone successions. In view of this the broad stratigraphical divisions originally proposed for the Taemas-Cavan area are equally applicable in the Wee Jasper area.

Some of the evidence for the ages ascribed to the species has been published by Philip and Pedder (1964) and Philip (1965), but again, more detailed arguments are either at press or in preparation.

I am grateful to E. D. Gill and T. A. Darragh for making available specimens in their care at the National Museum of Victoria. I also wish to express my thanks to W. A. Oliver of the U.S. Geological Survey, Washington, for information concern-

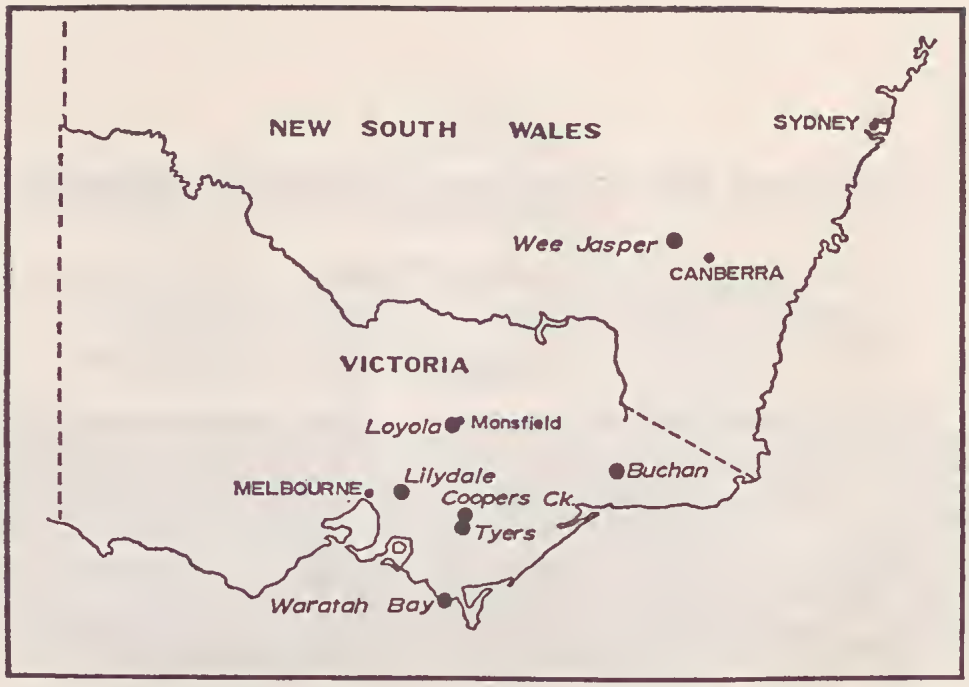

FIG. 1—Map of Vict. and part of N.S.W. Localities of corals described in the text are indicated by the larger circles.

ing the genus *Enterolasma*, and to D. L. Strusz of the University College of Townsville, for sending the manuscript of a paper describing the Spongophyllidae of the Garra Beds. B. R. Whan, of the technical staff of the University of New England's Geology Department drafted the scatter diagrams and photographed the other text-figures, and N. Petrasz of the same staff, assisted in the preparation of the thin sections. Most of the material used in the paper was collected in company with either G. M. Philip or J. H. Jackson, during field-work made financially possible by the University of New England's Research Grant No. 120.

Systematic Descriptions

Fossil collections referred to are abbreviated as follows:

AM——Australian Museum, Sydney
GSV——Geological Survey of Victoria, Melbourne
NMV——National Museum of Victoria, Melbourne
UM——University of Melbourne
UNE——University of New England, Armidale
UQ——University of Queensland, Brisbane.

Family SPONGOPHYLLIDAE Dybowski

Genus **Lyrielasma** Hill

1939 *Lyrielasma* Hill, p. 243, 244.
?1950 *Lyrielasma*, Wang, p. 224.
?1960 *Lyrielasma*, Oliver, p. 8, 10.
1962 *Lyrielasma*, Soshkina and Dobrolyubova in Orlov, p. 335.

TYPE SPECIES: *Cyathophyllum caespitosum* Chapman, redescribed below as *Lyrielasma chapmani* nom. nov.

DIAGNOSIS: Solitary (?) to fasciculate corallum with subcylindrical corallites; budding where observed, peripheral and non-parricidal. Peripheral stereozone prominent and in part composed of lamellar sclerenchyme; internal lamellar stereozones may also be present. Septa well developed, either radially or pinnately arranged, strongly carinate in early stages, later becoming less carinate or even smooth. Trabeculae parallel and more or less horizontal. Dissepiments elongate, steeply inclined and rarely lonsdaleoid; rare or absent in early stages, normally several deep in adult stages. Tabularium axially depressed, composed of predominantly closely spaced and incomplete tabulae.

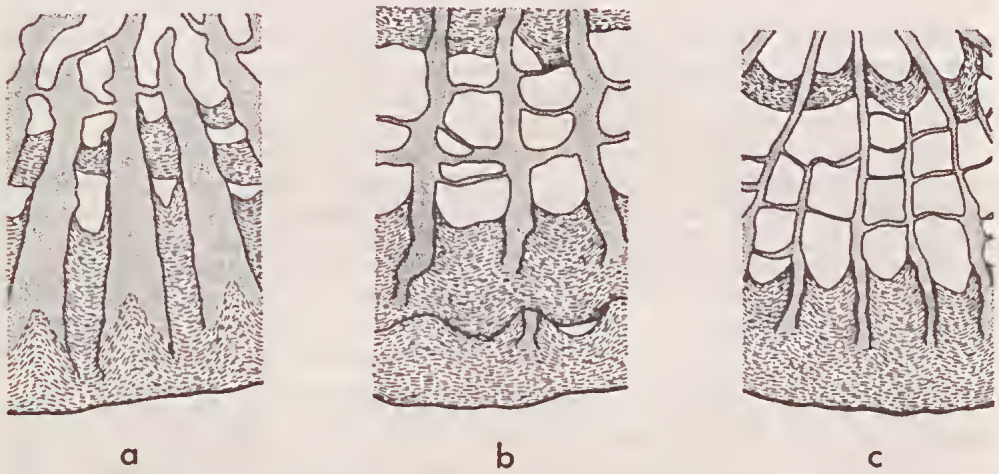

FIG. 2—*Lyrielasma* spp., × 16. Semidiagrammatic figures of transverse sections showing the relationship between the septa (stippled) and the peripheral lamellar stereome. (a) *Lyrielasma chapmani chapmani* nom. nov., UNE F8862, hypotype, Lilydale Limestone, Cave Hill, Lilydale, Vict.; (b) *Lyrielasma chapmani chapmani* nom. nov., UNE F8866, hypotype, same locality; (c) *Lyrielasma* sp. nov. cf. *L. chapmani* nom. nov., UNE F8933, hypotype, Coopers Creek Formation, Evans Brothers' Quarry, Coopers Creek, Vict.

REMARKS: Young individuals of *Lyrielasma* resemble *Enterolasma* Simpson (1900, p. 203-205) and *Cymatelasma* Hill and Butler (1936, p. 516, 517). However the resemblance diminishes as dissepiments are added during ontogeny.

Lyrielasma shares many features with *Grypophyllum* Wedekind (1922, p. 13), and serious consideration must be given to the question of whether it is, like *Hooeiphyllum* Taylor (1951, p. 173, 174), a junior synonym of Wedekind's genus. The literature at the writer's disposal shows that there are at least 37 species and varieties either originally described as *Grypophyllum*, or later transferred to it. Although most of these are spongophyllids, the total includes stringophyllids, bethanyphyllids, an endophyllid and a digonophyllid. The spongophyllids of this total, range in age through part of the Lower, to late Middle Devonian; there is much variation in their morphology and it seems probable that they can be successfully fragmented into shorter ranged genera.

Grypophyllum aggregatum Hill becomes part of the new genus *Embolophyllum* and perhaps some of the specimens currently referred to *Grypophyllum striatum*

would rest more easily in the same genus. Other species that should be excluded from *Grypophyllum* are: *G. carinatum* (Soshkina 1936, p. 60-62, 74, fig. 68-70; 1949, p.133-135, Pl. 52, fig. 3-8; Pl. 53, fig. 1-4; 1952, p. 96, Pl. 34, fig. 118), *G. gorskyi* Bulvanker (1934, p. 11-13, Pl. 5, fig. 4, 5; Soshkina 1949, p. 133, Pl. 44, fig. 5a, b; 1952, p. 95, 96, Fig. 89), both from the Givetian of the Urals, and *G. sailairicum* Bulvanker (1958, p. 145, 146, Pl. 51, fig. 1a-2) from the Eifelian of the Kuznetsk Basin. These are small solitary corals, and unlike *Grypophyllum, sensu stricto*, possess flanged septa.

From the species retained in *Grypophyllum* for the purposes of the present paper, two distinct species groups emerge. The more typical, that is the one including the type species *G. denckmanni* Wedekind (1922, p. 13-15, Fig. 13, 14), embraces about ten described species, known mainly from the Givetian of Europe and Asia. It consists of solitary (Engel and Schouppé 1958, p. 104) and weakly fasciculate corals (Middleton 1959, Fig. 4e) having steeply sloping calicular walls, thin smooth septa embedded peripherally in a moderately thick lamellar wall, and closely spaced, flat to axially depressed tabulae; the dissepimentarium is relatively broad and due to suppression of minor septa, may be of the herringbone type.

Another closely related species group centres around *Cyathophyllum vermiculare* Goldfuss (1826, p. 54, Pl. 17, fig. 4). Corals of this group are distributed from France to the Urals, particularly in Middle Devonian beds, and differ from species such as *G. denckmanni* in having a relatively thinner wall, more consistently developed minor septa and apparently an invariably solitary corallum. The genera *Stenophyllum* Wedekind (1925, p. 9, 10) and *Leptoinophyllum* Wedekind (1925, p. 4) are based on species of this group. The first is preoccupied by a myriapod (Verhoeff 1897, p. 122), the other is available if required, but has been merged in *Grypophyllum* by Birenheide (1961, p. 114).

Other species currently held in *Grypophyllum* deviate from the typical morphology in several ways. *G. compactum* Hill (1942a, p. 255, 256, Pl. 10, fig. 1-4) from the Givetian of Queensland and *G. graciliseptatum* Pedder (1964, p. 441-443, Pl. 67, fig. 1-19) from late Eifelian or early Givetian beds of western Canada may have axially elevated tabulae. *G. cornus* McLaren (in McLaren and Norris 1964, p. 10, 11, Pl. 3, fig. 3) a Givetian coral, also from western Canada, has an apparently thin wall, irregular septa and widely spaced tabulae. Another variation is seen in *G. gracile* var. *kuznetskiense* Bulvanker (1958, p. 145, Pl. 31, fig. 1, 2), from the Givetian of the Kuznetsk Basin; in this variety the dissepiments are extremely large, and despite the brevity of the minor septa, the dissepimentarium is not of the herringbone type.

A comparison of text-figures, prepared from the best Victorian material of *Lyrielasma*, with others drawn from Chinese specimens identified as *Grypophyllum* (Wang 1950, Pl. 7, fig. 56), suggests that there is no fundamental difference between the genera, in either the wall, which is lamellar, or the septa, which are embedded in it. However, the wall is proportionately thicker in *Lyrielasma* and the genera are further distinguished by the development of flanged septa in *Lyrielasma*, at least in early stages.

Fasciphyllum petshorense described by Soshkina (1949, p. 110, 111, Pl. 44, fig. 1-4; 1952, p. 97, Pl. 37, fig. 128) from the Emsian of the Urals is a species of *Lyrielasma*. Glinkski (1957, p. 97) contends that *Fascilphyllum* Schlüter (1885, p. 52) is a synonym of *Battersbyia* Milne-Edwards and Haime (1851, p. 151, 227), but in any case these genera have a narrower dissepimentarium and septa without flanges.

Definite occurrences of *Lyrielasma* are presently restricted to the late Gedinnian or Siegenian of Victoria (see below), Emsian of N.S.W. (*L. floriforme* Hill 1942b, p. 146, 147, Pl. 2, fig. 2), and the Emsian (see above) and Eifelian (see below) of the Urals. However, as Hill (1939, p. 245) noted, there are reasons to believe that the genus may also be represented in the Emsian of France (*Cyathophyllum dianthus* and *C. elongatum* Le Maître 1934, p. 152-154, Pl. 5, fig. 10-14; Pl. 18, fig. 7) and the Carnic Alps (*C. dianthus, sensu* Charlesworth 1914, Pl. 31, fig. 8). Other possible occurrences are in the late Gedinnian (?) Beck Pond Limestone of northern Maine (*L. annulatum* Oliver 1960, p. 10-12, Pl. 2, fig. 1-6; Pl. 3, fig. 1-5) and the Emsian (?) Malobachatskie Beds of the Sayano-Altai region of Siberia (*L. denticulata* Zheltonogova in Khalfina 1961, p. 379, Pl. D35, fig. 4). A septal stereozone is stated to be present in both the last named species, but descriptions make no mention of lamellar sclerenchyme.

Hill (1939, p. 245) drew attention to the similarity between *Lyrielasma* and certain Middle Devonian corals from the Eifel. Although two of the latter were later figured and unequivocally identified as *Lyrielasma* by Wang (1950, Pl. 7, fig. 57; Pl. 9, fig. 75), they are here excluded from the genus because of the absence of a peripheral stereozone. They may be solitary, and if so would be congeneric with species such as *'Grypophyllum' carinatum*, discussed earlier in these remarks. *Lyrielasma sperabile* Crickmay (1962, p. 5, Pl. 1, fig. 7; Pl. 3, fig. 1-3) from subsurface Givetian beds in western Canada, is also excluded from the genus; it has a thin wall, virtually or entirely smooth septa, and in spite of the axial elevation of the tabulae is probably close to *Grypophyllum*.

Lyrielasma chapmani nom. nov.

The original name *Cyathophyllum subcaespitosum* is a junior primary homonym of *C. subcaespitosum* Meek (1873 and in King 1877) and must be rejected (I.C.Z.N. Articles 59, 60). It is therefore proposed that the trivial name be replaced by *chapmani*, in honour of the original author of the Victorian species, Frederick Chapman.

Previous literature records the species in limestones at Lilydale, Loyola, Tyers R. and questionably from Waratah Bay. However, differences have been noted between the holotype and most other topotypes from Lilydale, and also between the holotype and specimens from Loyola, Tyers R. and Waratah Bay.

Although recent field-work has added to the existing collections from all these localities, there is still too little material for final settlement of the precise taxonomy of the species. The view adopted tentatively for the present work is that the specimens from Lilydale, Waratah Bay and perhaps Loyola, pertain to the nominate subspecies, while a distinct subspecies, previously named *praecursor*, is represented by the specimens from Tyers R.

Lyrielasma chapmani chapmani nom. nov.

(Pl. 1, fig. 1-14; Pl. 2, fig. 1-9; Fig. 2a, b, 3a-4)

1925 *Cyathophyllum subcaespitosum* Chapman, p. 112, Pl. 13, fig. 15-16b.
1939 *Lyrielasma subcaespitosum* (Chapman), Hill, p. 244-246, Pl. 14, fig. 1-6; Pl. 15, fig. 6, 7.
1949 *Lyrielasma subcaespitosum* (Chapman), Stumm, p. 34, Pl. 16, fig. 3-5.
1954 *Lyrielasma ? subcaespitosum* (Chapman), Hill, p. 111, Pl. 7, fig. 14a, b.
1956 *Lyrielasma subcaespitosum* (Chapman), Hill in Moore, p. 306, fig. 208, 1a-c.
1962 *Lyrielasma subcaespitosum* (Chapman), Phillip, p. 188, Pl. 28, fig. 6, 7.
non 1873 *Cyathophyllum subcaespitosum* Meek, p. 470 (= *Dorlodotia subcaespitosa*, see Sando 1965, p. 11-15, Pl. 4).

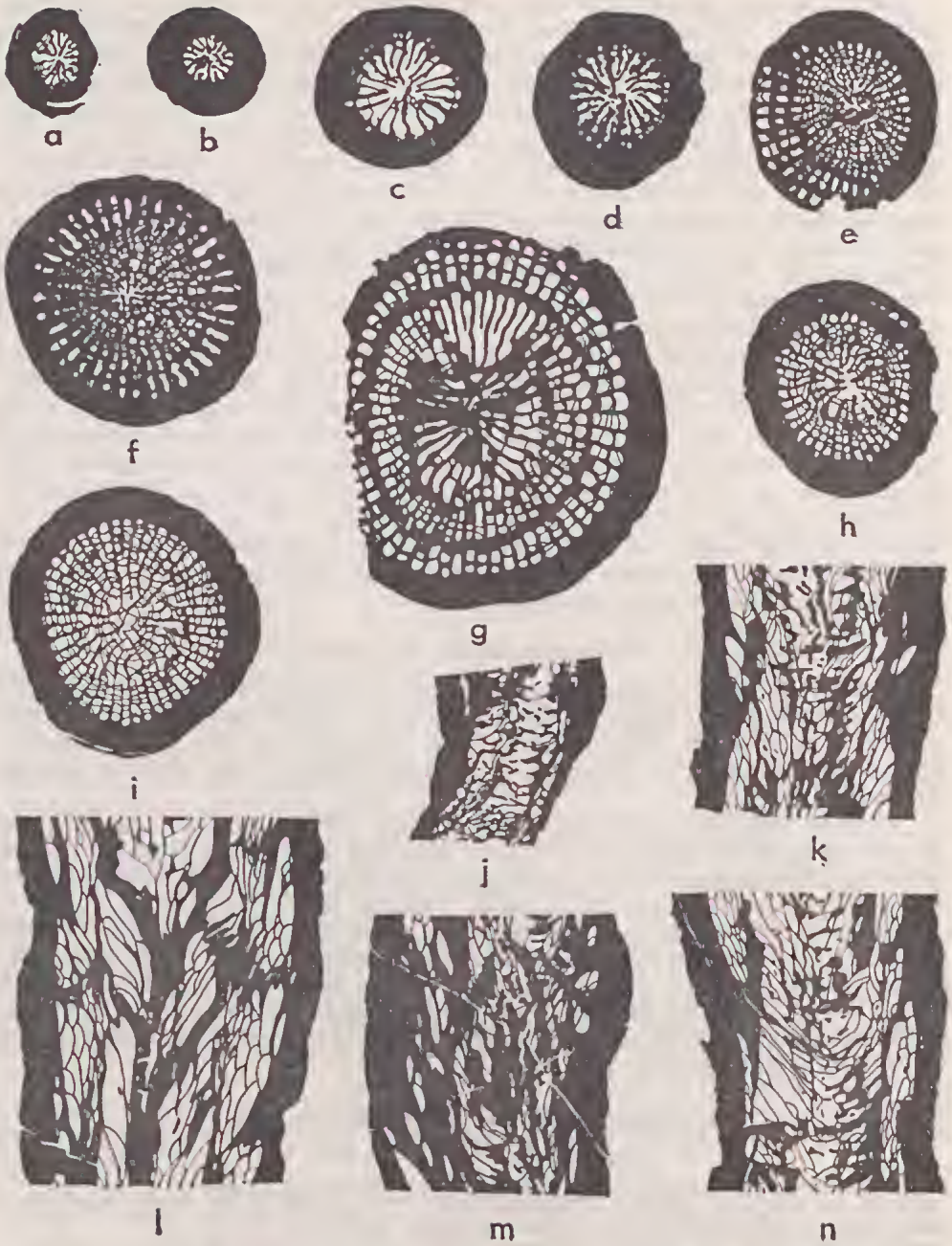

FIG. 3—*Lyrielasma chapmani chapmani* nom. nov., ×3. Hypotypes from the Lilydale Limestone at Cave Hill, Lilydale, Vict. Fig. a-i are transverse sections and j-n longitudinal sections. (a) UNE F8877; (b) UNE F8874; (c) UNE F8876; (d) UNE F8867; (e) UNE F8861; (f) UNE F8871; (g) UNE F8866; (h) NMV P23013; (i) UNE F8865; (j) NMV P23009; (k) NMV P23013; (l) UNE F8863; (m) UNE F8862; (n) UNE F8865.

non 1877 *Cyathophyllum subcaespitosum* Meek, Meek in King, p. 60, 61, Pl. 5, fig. 4-4b (= *Orygmophyllum* (?) *whitneyi*, see Sando 1965, p. 17, Pl. 6, fig. 6-11). Pl. 19, fig. 4a, b.

non ? 1962 *Lyrielasma subcaespitosum* (Chapman), Soshkina and Dobrolyubova in Orlov, Pl. 19, fig. 4a, b.

MATERIAL: Records at the National Museum of Victoria indicate that the holotype is now in six parts; four of these are thin sections, catalogued P15969-P15972, and two are hand specimens, numbered P1731 and P14065. During a visit to the Museum in March, 1965, thin sections P15970-P15972 only could be found. The paratype, NMV P13303, has not been sectioned, and like parts of the holotype could not be found in March, 1965. Both specimens were collected by A. W. Cresswell from the Lilydale Limestone (Siegenian) at Cave Hill, Lilydale, Vict.

In addition to the type series there are 29 topotypes, registered as follows: AM F1329a, b (two specimens), collectors unrecorded; UM TS1628, TS1629 (same specimen), TS1630-TS1632 (another specimen), both collected by G. M. Philip; NMV P22996, P23006, P23009, P23013, P23016, P23018, collectors unrecorded; UNE F8859-F8864, collected by G. M. Philip and the writer; UNE F8865-F8877, collected by the writer.

Other hypotypes include two specimens collected by Curt Teichert from the Kiln Member (Siegenian) of the Waratah Limestone at Waratah Bay, Vict. and a specimen collected by A. N. Carter from the Bird Rock Member (Siegenian) of the same formation. These specimens were studied by Hill and the one collected by Carter is now registered UQ F17101; Teichert's material was returned to the University of Melbourne in 1953, but at the time of writing has yet to be catalogued.

Two other hypotypes, UM TS621, TS622 (same specimen) and UNE F8878, are from the Loyola Limestone (Siegenian) at Griffith's Quarry, Loyola, near Mansfield, Vict. The first was collected by E. A. Ripper and the second by the writer.

DIAGNOSIS: Corallum fasciculate, perhaps in some cases solitary; increase, where known, peripheral; mean diameter of adult corallites not exceeding 16 mm, typically 6 to 12 mm. Calice with steep sides and deep central depression. Wall partly lamellar, normal thickness 1·2 to 1·5 mm, maximum 3·0 mm; 18 × 2 to 30 × 2 septa per adult corallite. Trabeculae horizontal. In early stages septa strongly flanged, dissepiments and tabulae few or absent. In later stages septa less flanged, dissepiments up to 7 or 8 deep, tabulae numerous and deeply depressed at the axis.

DESCRIPTION: While some specimens from Lilydale are fasciculate and others almost cerioid, most are apparently single corallites. This is largely and perhaps entirely due to post mortem damage, which characterizes many of the fossils from the Lilydale Limestone. Non-paricidal peripheral budding has been observed in one specimen (Philip 1962, Pl. 28, fig. 6). Individual corallites are initially ceratoid, subsequently subcylindrical, and may be elliptical or oval, rather than circular in transverse section; rejuvenescence occurred from time to time. Although the maximum mean diameter is 16 mm, most corallites are 12 mm or less in diameter. Periodic layers of selerenchyme show that the calice was steep sided and in some cases exceptionally depressed at the centre.

In corallites of less than 5 mm or so diameter, the marginarium consists almost exclusively of a partly septal and partly lamellar stereozone, with a width equivalent to approximately one-half the radius of the corallite. In larger corallites the width may increase to 3·0 mm, but more usually remains about 1·2 to 1·5 mm; thus relatively the thickness decreases during ontogeny.

Septa radial, or less commonly, pinnate in arrangement. At first the major are strongly flanged and the minor may be confined to the stereozone. Later the flanges

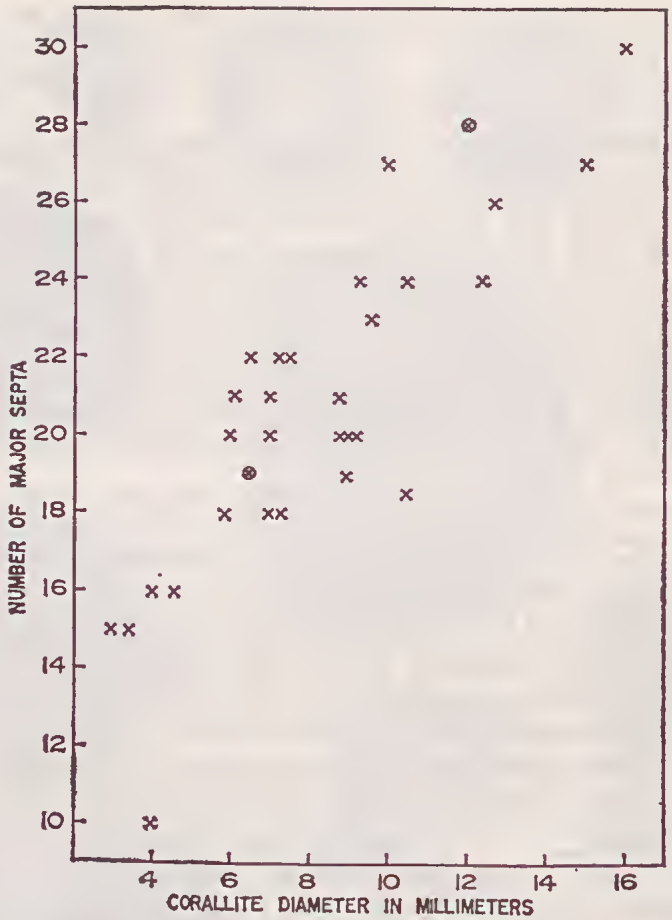

FIG. 4—*Lyrielasma chapmani chapmani* nom. nov. Scatter diagram of number of major septa × diameter in 27 specimens from the type locality. Points derived from the holotype are encircled.

are generally less pronounced and in some case entirely lost, and the minor septa increase to between one-half and three-fifths of the length of the major, which terminate near the axis. The cardinal and counter septa are variably developed, one or both may be longer than other major septa. Septal counts at various diameters are given in Fig. 4. Trabeculae are essentially parallel, and although flexed in places, are directed more or less horizontally towards the axis.

Dissepiments develop slowly during ontogeny; corallites of less than 5 mm diameter rarely possess more than a few, and may be quite devoid of them. At 10 mm diameter there are approximately 4 or 5 rows and in the largest corallites 7 or 8 rows of dissepiments are present. Although differing in size and convexity, the dissepiments are apparently invariably steeply inclined. Lonsdaleoid dissepiments have not been observed in any of the specimens studied.

Tabulae are also sporadic at first, suggesting that their function of support was shared with the flanges. However, during subsequent stages they are invariably present and are commonly strongly depressed at the axis.

Internal lamellar stereozones may occur periodically and are especially characteristic of large specimens.

REMARKS: The specimen from the Eifelian of the Urals, identified by Soshkina and Dobrolyubova as *Lyrielasma subcaespitosum*, is here tentatively excluded from the species. It just falls within the range of the species in terms of degree of carination and abundance of septa, but the relative width of the tabularium is greater and the sclerenchymal investment general, rather than confined to definite layers.

Lyrielasma chapmani praecursor Philip 1962

1962 *Lyrielasma subcaespitosum praecursor* Philip, p. 189, 190, Fig. 7a, b; Pl. 28, fig. 11, 12.

REMARKS: This subspecies was erected for specimens of *Lyrielasma subcaespitosum* from Tyers R., which differed from topotypes in details of size, internal and peripheral stereozones, carination, lengths of counter and minor septa and in the incidence of lonsdaleoid dissepiments. Comparison of additional specimens (UNE F8879, F8880) from Tyers R. with the abundant material now available from Lilydale, leads to the rejection of some of the criteria originally cited as distinguishing the subspecies. Nevertheless, recognition of the subspecies is continued on the basis of the occurrence of interior stereozones, and the absence of lonsdaleoid dissepiments in the nominate subspecies.

Lyrielasma sp. nov., cf. **L. chapmani** nom. nov.

(Pl. 2, fig. 10, 12; Fig. 2c)

MATERIAL: UNE F8933, a solitary corallite, incomplete proximally as well as distally, collected by G. M. Philip and the writer in the Coopers Creek Formation (late Gedinnian or Siegenian) at Evans Brothers' Quarry near Coopers Creek, Vict. The site of this quarry is shown by Thomas (1942, p. 358); however the quarry does not expose Jordan River Beds as the reversed symbols suggest.

DESCRIPTION: Prior to sectioning, the length was 22 mm and the diameter at the lower end 8 mm; at the upper end, where the corallite was elliptical in cross section, the mean diameter was 10 mm. In addition to a peripheral lamellar stereozone varying in width from 0·3 to 1·0 mm, interior stereozones periodically invest the dissepimentarium and tabularium.

Septa 24 × 2 in number, wavy and slightly pinnate in arrangement about an elongated cardinal, or counter septum; other major septa extend between two-thirds and the entire distance to the axis, while the minor are a little over one-half as long. When viewed in longitudinal section the trabeculae are inclined at between 0° and 25° to the horizontal.

7 to 10 rows of rather elongate and steeply inclined dissepiments are present.

The tabularium is slightly less than one-third of the width of the corallite, and perhaps to some extent due to subsequent distortion, slopes in one direction in the lower part of the longitudinal section. Higher in the corallite, tabulae are more normal for the genus, being somewhat axially depressed.

REMARKS: The specimen differs from known specimens of *Lyrielasma chapmani* of comparable size, in having a wider dissepimentarium composed of more numerous dissepiments. It is probably a new species, but obviously more material is required; before a definite stand can be taken on its taxonnomic position.

Murray (1887, p. 45) noted that McCoy had identified 'traces of a lamelliferous coral closely allied to *Diplophyllum caespitosum*' in limestones, then regarded as Silurian, at Coopers Creek. Although these specimens are presumably lost, it is an interesting speculation that they may have been representatives of the same species.

True *Diplophyllum caespitosum* is an American Middle Silurian species and has recently been redescribed by Oliver (1963, p. 3).

Genus **Embolophyllum** nov.

NAME DERIVATION: Gk, εμβολος = wedge, and φμλλον = leaf.

TYPE SPECIES: *Acanthophyllum asper* Hill, redescribed below.

DIAGNOSIS: Corallum fasciculate, commonly dendroid but also phaceloid; corallites at first ceratoid to trochoid, later subcylindrical. Increase by both lateral and peripheral budding. Calice deep, steep sided. Wall thin to moderately thick, not reinforced by lamellar sclerenchyme. Septa radial to weakly pinnate in arrangment, typically expanded at the base so as to appear wedge shaped in transverse section; rarely withdrawn from the periphery. Carinae strongly to moderately developed in the tabularium. Trabeculae essentially parallel in longitudinal section, directed inwards, initially at 10° to 30° to the horizontal, but steepening towards the axis, to a possible maximum of 45°. Dissepiments numerous, predominantly vesicular rather than elongate. Tabulae incomplete, closely spaced and characteristically inclined towards the axis.

REMARKS: In growth form and other features the new genus resembles *Lyrielasma, Grypophyllum* and *Battersbyia* (= ? *Fasciphyllum*), all of which are discussed earlier in the paper. From the first it is distinguished by the absence of lamellar sclerenchyme, and from the others by the presence of pronounced carinae in the tabularium; *Battersbyia* and *Fasciphyllum* are further distinguished by the poverty of their dissepimentarium. *Acanthophyllum* Dybowski (1873, p. 339), in which the type species of *Embolophyllum* originally resided, is a solitary genus of corals, and as Bulvanker (1958, p. 95) and Birenheide (1961, p. 84) have independently pointed out, possesses a peripheral platform.

Although Wedekind's (1922, p. 8, 16) genus *Neostringophyllum* has been assigned to various families and has frequently accommodated disphyllinids (Soshkina 1952, Soshkina and Dobrolyubova in Orlov 1962, Bulvanker 1958, Spasskiy 1960, Besprozvannykh 1964), we must agree with Hill (in Moore 1956), Birenheide (1961) and others, that it is close to *Grypophyllum* and *ipso facto*, to *Embolophyllum*. Variation is wide, even among the spongophyllids referred to *Neostringophyllum*, and criteria cited in distinguishing one species group from *Embolophyllum* would not be the same as those used to distinguish another group. However, the new genus differs from all species of *Neostringophyllum* in being fasciculate.

Apart from the species described in this paper, the only other that seems certain to belong to *Embolophyllum* is *Cyathophyllum schucherti* Swartz (1913, p. 203, Pl. 20, fig. 5, 8, 9) from the Keyser Limestone of Maryland. The problems concerning the age of the Keyser are well known (Berdan 1964), but on the basis of Boucot's (1957, p. 1702; 1960, p. 291) correlations, *Embolophyllum schucherti* is probably an early Gedinnian species. This being so, the established range of the genus is Gedinnian to early (?) Emsian. *Neostringophyllum* on the other hand, is essentially a late Eifelian and Givetian genus, and even if corals such as *Cyathophyllum torquatum, sensu* Le Maître (1934, Pl. 5, fig. 16, 17) and *C. torquatum* var. *orientale* Reed (1922, Pl. 1, fig. 1-3) were included in it, the generic range, which would then be late Emsian to Frasnian (?), would still not overlap that of *Embolophyllum*.

Questions concerning the generic position of *Cyathophyllum mansfieldense* Dun cannot properly be answered until the type specimen is located and re-examined. The common variety at Loyola is a fasciculate coral and in several ways resembles

Embolophyllum. Apart from the probability of the type being a solitary coral, reluctance to ascribe the species definitely to *Embolophyllum* derives from the structure of the septa at the periphery. In places a normal septal stereozone is developed, but elsewhere trabeculae are bunched between the septa. Such an arrangement is often seen in other corals with naotic tendencies, particularly in Wedekind's (1923, p. 29, 35, Fig. 7; 1924, p. 76, Fig. 106-108) genus *Dohmophyllum* (Birenheide 1963, Fig. 3). Like *Cyathophyllum mansfieldense*, species of *Dohmophyllum* (= *Astrodiscus* Ludwig 1866, p. 212, Pl. 58; *Trematophyllum* Wedekind 1924, p. 72, 75, Fig. 104, 105; *Pseudoptenophyllum* Wedekind 1925, p. 60, 78, Pl. 16, fig. 95, 96) may be solitary or weakly compound (Frech 1885, Pl. 4, fig. 1-4) but have a wide peripheral platform and a patelloid corallum, at least in early stages. They are also of a different age, for with the exception of one recorded Upper Devonian occurrence (Unsalaner 1951, Pl. 1, fig. 2), *Dohmophyllum* is an Emsian (rare) and Middle Devonian genus, whereas *Cyathophyllum mansfieldense* is either Gedinnian or Siegenian.

Embolophyllum asper (Hill 1940)

(Pl. 2, fig. 11, 13-15; Pl. 3, fig. 6, 9; Pl. 4, fig. 1, 6; Fig. 5a-6)

1940b *Acanthopyllum asper* Hill, p. 252, Pl. 9, fig. 3a, b, ? 4.

MATERIAL: The type series consists of the holotype, UQ F4270, and one other figured specimen, UQ F4272; both were collected by Dorothy Hill from the 'Lower Middle Devonian' at the 'first karst on Cave Flat road from Wee Jasper, N.S.W.'.

9 hypotypes from the same general area have been studied in connection with the present work. UNE F8911-F8917 were collected 50 to 60 ft above the base of the Taemas Limestone in a measured section on Goodradigbee R., approximately 8·5 kilometres N of Wee Jasper, N.S.W., grid reference 663714. UNE F8918 was gathered loose, about 60 ft above the base of the same limestone in another section near Goodradigbee R., approximately 6·6 kilometres N of Wee Jasper, grid reference 668695. UNE F8919 was collected 15 ft above the base of the Taemas Limestone in the section that also provided hypotypes F8911-F8917. In each instance the collectors were J. H. Jackson and the writer, and the age of the beds late Siegenian, or Emsian.

DIAGNOSIS: Corallum fasciculate, increase peripheral and lateral; mean diameter of adult corallites 16 to 23 mm. Calice steep sided. Wall thin, at septal bases typically wedge shaped in transverse section. Septa weakly bilateral in arrangement, normally thin and smooth near the periphery, or even withdrawn, becoming thicker and carinate in the tabularium. Septal counts 25 × 2 to 30 × 2 at maturity. Dissepiments globose to elongate, up to about 10 deep. Tabularium normal for family.

DESCRIPTION: Corallum fasciculate, generally dendroid rather than phaceloid; individual corallites at first are trochoid to ceratoid, but later become subcylindrical; the largest have a mean diameter of 16 to 23 mm. Rejuvenescence and both lateral and peripheral budding are not infrequent; a particularly good example of peripheral budding, involving 13 or more offsets, is seen in one corallite of the specimen catalogued as UNE F8913 (Fig. 5a). All available specimens are embedded in matrix, but it is clear from the arrangment of the dissepiments that the sides of the calice would be steep.

In transverse section the wall usually appears as a series of side-by-side wedges, which are due partly to expanded septal bases and partly to epithecal investment of these bases; in some specimens the wedge appearance is faint and may be entirely

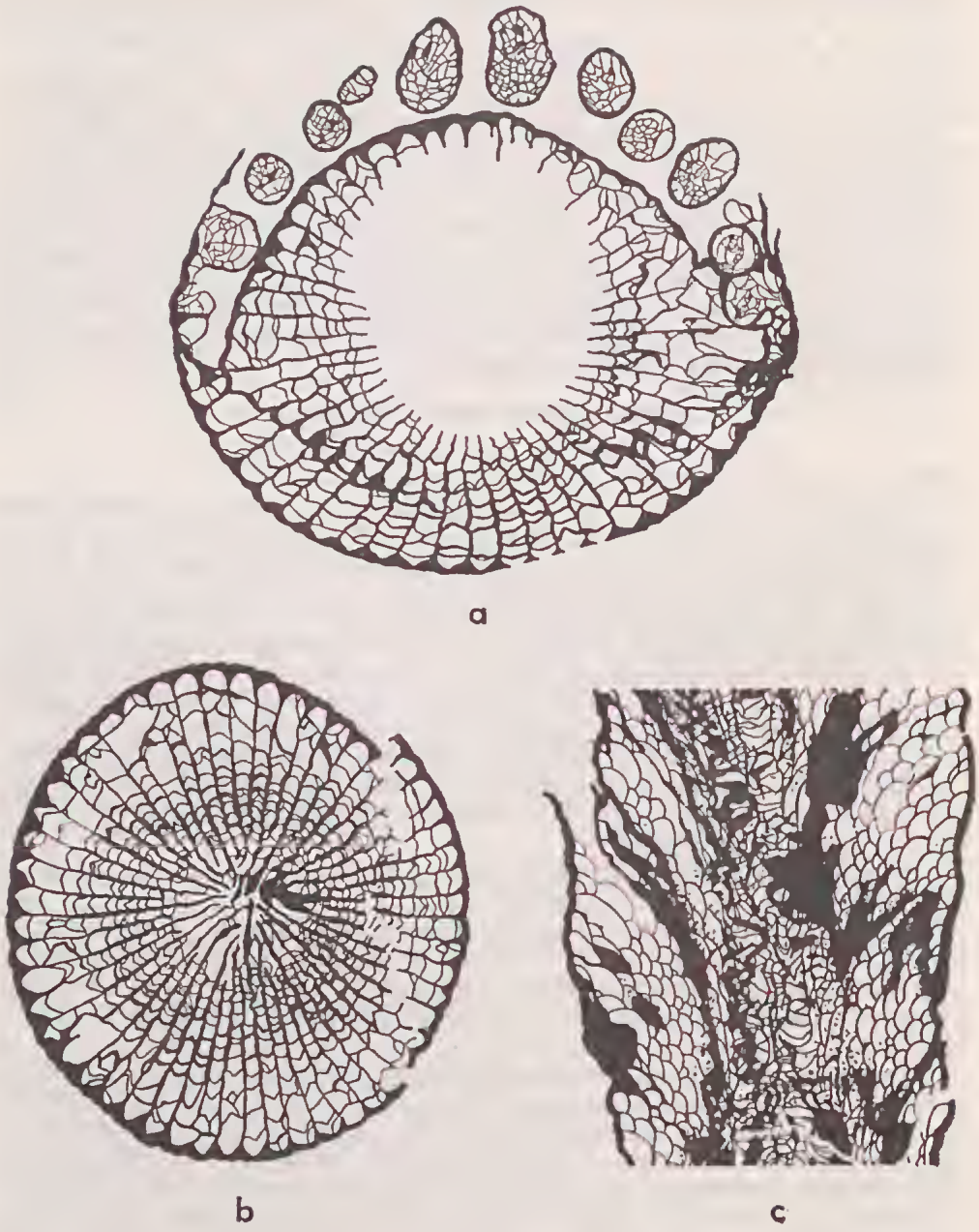

FIG. 5—*Embolophyllum asper* (Hill), × 3. (a, b) UNE F8913, hypotype, transverse sections; (c) UNE F8911, hypotype, longitudinal section. Both specimens were collected 50 to 60 ft above the base of the Taemas Limestone near Wee Jasper, N.S.W.

absent. Shallow septal grooves and low interseptal ridges are sporadically developed. In its thinnest places the wall is normally between 0·1 and 0·3 mm thick, but may be as much as 0·5 mm.

The septal arrangement is weakly pinnate about an elongated septum believed to be the cardinal septum. Near the periphery septa are generally thin and smooth, but towards the axis commonly thicken and bear carinae. Major septa terminate near the supposed cardinal septum and are of unequal length; minor septa only

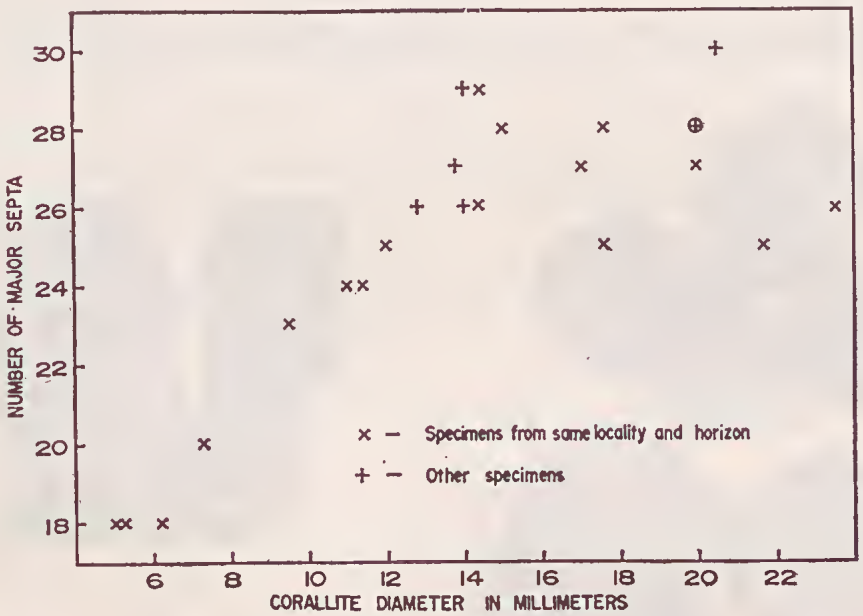

FIG. 6—*Embolophyllum asper* (Hill). Scatter diagram of number of major septa × diameter in 10 specimens from four localities in the Taemas Limestone near Wee Jasper, N.S.W. Grid reference of the 'same locality' referred to is 663714. A point derived from the holotype is encircled.

just enter the tabularium. Septa of both orders may be withdrawn peripherally, especially during the early and late stages of a corallite's development. Septal counts are expressed as a scatter diagram in Fig. 6.

Dissepiments are globose to elongate and decrease only slightly in inclination towards the periphery; they are approximately 6 deep in corallites of about 10 mm diameter and 8 to 10 deep in fully grown specimens.

The tabularium is one-third to two-fifths of the total width of the corallite and consists of closely spaced and incomplete tabulae; an axial sag may or may not be present.

REMARKS: Although the type specimen was described as solitary, all specimens subsequently collected from the type area are colonial, and there is in fact, on one side of the holotype, a small corallite suggesting that this specimen is also part of a fasciculate colony.

Embolophyllum aggregatum (Hill)

It was not evident at first that *Embolophyllum aggregatum* and *E. asper* are especially closely related; indeed they were ascribed to different families. However subsequently, specimens have been collected which are both stratigraphically and morphologically intermediate, and it is now highly probable that *E. aggregatum* descended directly from *E. asper*. This phylogeny involved firstly a diminution of corallite diameter accompanied by a change from dendroid to phaceloid corallum, and secondly a dilation of the septa with consequent development of a peripheral stereozone.

The second is perhaps a comparatively minor step, but is nevertheless expressed taxonomically by the erection of a new subspecies for the forms preceeding it.

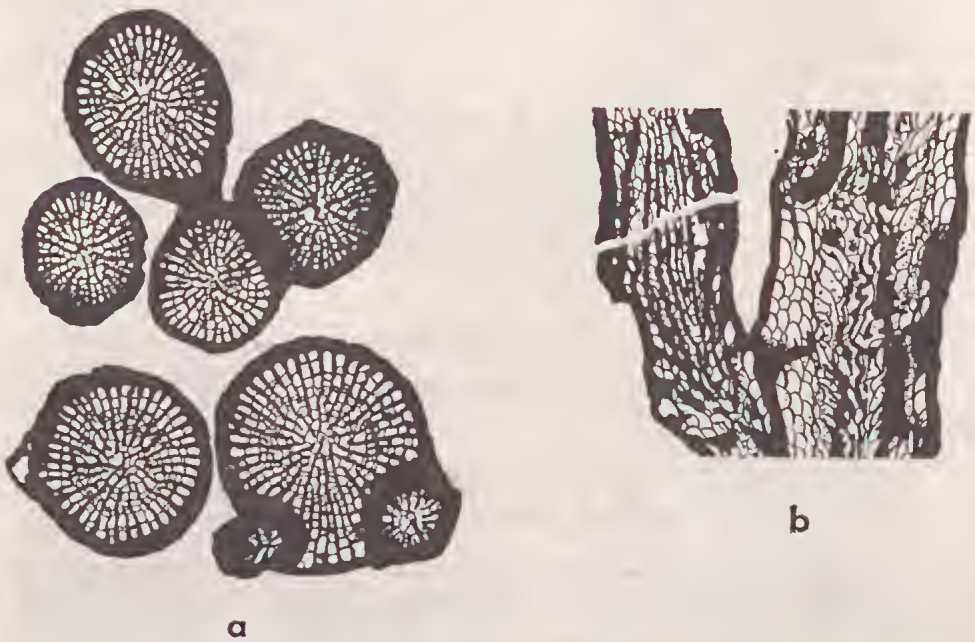

FIG. 7—*Embolophyllum aggregatum aggregatum* (Hill), × 3. (a) UNE F8885, hypotype, transverse section; (b) same specimen, longitudinal section. 588 to 638 ft above the base of the Taemas Limestone, near Wee Jasper, N.S.W.

Embolophyllum aggregatum aggregatum (Hill 1940)

(Pl. 3, fig. 3; Pl. 4, fig. 3-5, 7-9; Fig. 7a-8)

1940b *Grypophyllum aggregatum* Hill, p. 268, 269, Pl. 10, fig. 8; Pl. 11, fig. 1.
? 1942c ? *Grypophyllum* ? *aggregatum* Hill, Hill, p. 183, Pl. 6, fig. 4.

MATERIAL: The holotype, AM F10132, was presented to the museum in 1904 by Miss Yeo and is stated (Hill 1940b) to be from the 'Lower Middle Devonian Cave Limestone, Wee Jasper, Goodradigbee R.'; the current view is that it was probably obtained from an Emsian horizon within the Taemas Limestone. A paratype, UQ F4314, is simply located (Hill 1940b, legend Pl. 10) 'Wee Jasper'.

A further 19 specimens have been collected by J. H. Jaekson and the writer from the type area. Of these, UNE F8885-F8897 occurred between 588 and 638 ft

above the base of the Taemas Limestone in a measured section, approximately 3 kilometres N of Wee Jasper, N.S.W., grid reference 677658, and UNE F8898-F8903 between 523 and 528 ft above the base of the same limestone in another section, approximately 8·5 kilometres N of Wee Jasper, grid reference 661711.

DIAGNOSIS: Corallum phaceloid, increase peripheral and lateral; adult corallite diameter 6·0 to 11·5 mm. Calice steep sided. Septa carinate and dilated, especially at the periphery where there is a stereozone up to 0·5 mm thick; septal counts in adult corallites 18 × 2 to 23 × 2. Dissepiments steeply inclined, normally 2 to 5 deep. Tabularium strongly depressed medianly.

DESCRIPTION: The corallum is large, fasciculate and commonly phaceloid. Individual corallites are subcylindrical, but in places may be flattened by contact with neighbouring corallites; their mean diameter when fully grown is normally 6·0 to 9·5 mm and exceptionally as much as 11·5 mm. Evidence of rejuvenescence has not been observed; however both lateral and peripheral budding can be seen in the hypotypes studied. Inclination of the dissepiments and slope of the tabulae indicate a deep calice with steep sides. There are no indications of septal grooves or interseptal ridges.

The peripheral wall is typically 0·3 to 0·5 mm thick, but whether this is entirely or just partly a septal stereozone is not clear, due to poor preservation. Septal arrangement is either radial or weakly pinnate. Major septa are unequal in length, the longest penetrate the axial region, while the shortest extend less than one-quarter

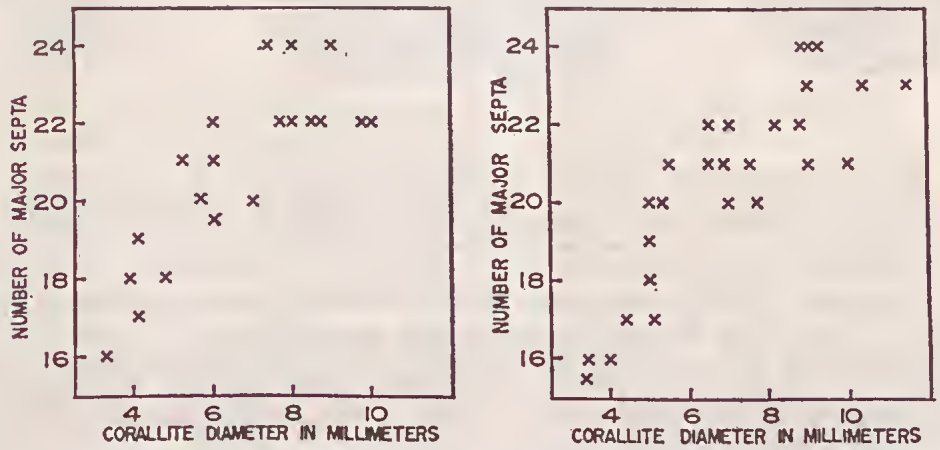

FIG. 8—*Embolophyllum aggregatum aggregatum* (Hill). Scatter diagrams of number of major septa × diameter. Left hand diagram based on 13 specimens collected between 588 and 638 ft above the base of the Taemas Limestone at a locality (grid reference 677658) near Wee Jasper, N.S.W. Right hand diagram based on 6 specimens collected from 523 to 528 ft above the base of the same limestone at another locality (grid reference 661711) near Wee Jasper.

of the distance across the tabularium; peripheral withdrawal is unknown. Both orders are carinate and dilated; towards the periphery dilation may be especially prominent. Numerical details of the septa are given in the scatter diagrams of Fig. 8.

Although variable, dissepiments are, on the whole, relatively large, elongate, and steeply inclined even at the periphery. Normally they are in 2 to 5 rows and in places may be thinly invested by sclerenchyme.

The tabularium, which is about two-fifths of the total width of the corallite is constituted predominantly of somewhat inflated, inwardly sloping and incomplete tabulae.

Embolophyllum aggregatum cracente subsp. nov.

(Pl. 3, fig. 1, 2, 4, 5, 7, 8; Pl. 4, fig. 2; Fig. 9a-10)

NAME DERIVATION: L. *cracens* = graceful.

TYPE SERIES: Holotype and paratypes 1-6, UNE F8904-F8910 respectively, collected by J. H. Jackson and the writer 443 to 448 ft above the base of the Taemas Limestone (early Emsian part), in a measured section on Goodradigbee R. approximately 8·5 kilometres N of Wee Jasper, N.S.W., grid reference 661711.

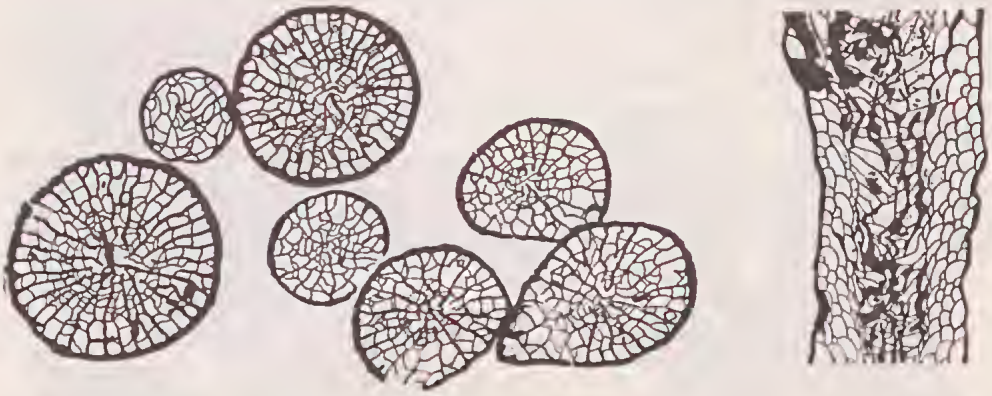

FIG. 9—*Embolophyllum aggregatum cracente* subsp. nov., × 3. (a) UNE F8906, paratype 2, transverse section; (b) UNE F8907, paratype 3, longitudinal section. Both specimens were collected between 443 and 448 ft above the base of the Taemas Limestone near Wee Jasper, N.S.W.

DIAGNOSIS: Corallum phaceloid, locally subcerioid, increase peripheral and lateral; adult corallite diameter 7·5 to 14·5 mm, normally 8·0 to 11·0 mm. Calice with steep sides. Septa carinate, thin, except for some peripheral dilation; septal counts 17 ×2 to 21 × 2 in fully grown corallites; minor septa may be withdrawn from periphery. Dissepiments steeply inclined, 2 to 4 rows in average corallites. Tabularium typical of family.

DESCRIPTION: Corallum large, phaceloid; individual corallites circular to elliptical in cross section; commonly they are sufficiently crowded for the corallum to be locally subcerioid. Rejuvenescence, lateral budding and peripheral budding are all seen in the type series. Adult corallites vary from about 7·5 to 11·0 mm in diameter, but in exceptional cases may exceed 14·0 mm. Longitudinal sections indicate that the calice is deep with steep sides.

The wall is normally 0·1 to 0·3 mm thick, but reaches a maximum of 0·5 mm. Septa radial to weakly pinnate in arrangement, carinate and thin, except for variable dilation at the periphery; in extremely rare instances there is a suggestion of a peripheral stereozone. Major septa vary to the extent that the shortest project only slightly into the tabularium while the longest extend to the axis or beyond. Minor septa are equally variable: some are almost completely suppressed, while others

enter the tabularium. In young corallites both orders of septa are discontinuous or withdrawn; later, peripheral withdrawal of the minor septa may persist locally, but the major are almost invariably complete. Numbers of septa at given diameters are shown by scatter diagram in Fig. 10. An average dissepimentarium consists of about 2 to 4 rows of moderately sized and steeply inclined dissepiments; in large corallites with a diameter of the order of 14 mm, there are as many as 8 or 9 rows.

Tabulae are incomplete, closely spaced and those at the margin are invariably inwardly inclined. Breadth of tabularium is one-third to two-fifths of the width of the entire corallite.

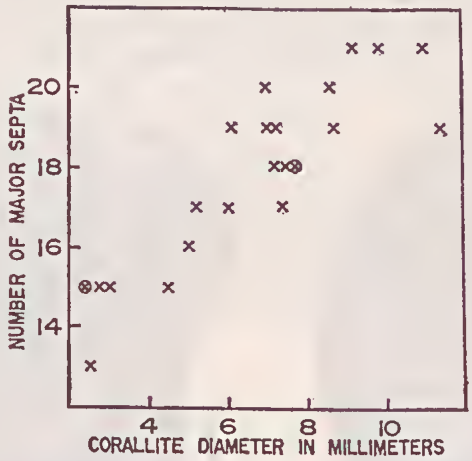

FIG. 10—*Embolophyllum aggregatum cracente* subsp. nov. Scatter diagram of number of major septa × diameter in the 7 specimens constituting the type series. Points derived from the holotype are encircled.

REMARKS: The new subspecies differs from the nominate subspecies in having larger, generally more closely spaced corallites, and more numerous and less dilated septa. Compared with *E. asper* it is phaceloid to subcerioid rather than dendroid, the individual corallites are smaller and the number of septa less.

Embolophyllum aequiseptatum (Hill)

This species was first recognized in the Cavan Bluff Limestone on Clear Hill overlooking Murrumbidgee R. in the Taemas-Cavan area of N.S.W.; subsequently it has been identified in the Garra Beds and Nubrigyn Limestone of the Molong-Wellington area, N.S.W., and in limestones at Buchan and on Tyers R. in Vict.

D. L. Strusz has acquired further specimens from the Garra Beds and regards them as representing a new species. The single specimen from Tyers R. has unusually thick septa with correspondingly thin interseptal loculi and is probably a new species. Minor differences between specimens from the Buchan Caves and Cavan Limestones suggest that they should be referred to distinct subspecies. The Nubrigyn specimens (K. H. Wolf in Johnson 1964, p. 98) have not been described, nor have they been seen by the writer.

Embolophyllum aequiseptatum aequiseptatum (Hill 1940)

(Pl. 5, fig. 2, 4, 6, 7; Pl. 6, fig. 3, 4, 6; Fig. 11a-12)

1940b *Acanthophylllum aequiseptatum* Hill, p. 251, Pl. 9, fig. 1, 2.
1959 *Acanthophyllum aequiseptatum* Hill, Browne, p. 118.

non 1942c *Acanthophyllum aequiseptatum* Hill, Hill, p. 183, Pl. 6, fig. 1 (= n.sp.).
non 1950 *Acanthophyllum aequiseptatum* Hill, Hill, p. 139, Pl. 5, fig. 1 (= subsp. *buchanense*).
non 1962 *Acanthophyllum aequiseptatum* Hill, Philip. p. 184, 185, Pl. 26, fig. 2, 3 (= n.sp.).

MATERIAL: Holotype, AM F9577, collected by A. J. Shearsby at Clear Hill, Parish of Cavan, N.S.W. Paratype, AM F17102, collected by W. S. Dun at Cavan N.S.W. It is believed that both of these came from the Cavan Limestone of late Siegenian or Emsian age.

5 hypotypes are from collections made by J. H. Jackson and the writer in the Cavan Limestone of the Wee Jasper area, N.S.W. UNE F8920, F8921 are from the W bank of Goodradigbee R., 6 kilometres N of Wee Jasper, grid reference 673688, while UNE F8922, F8935, F8936 are from the N end of Barbers' Island, about 11 kilometres N of Wee Jasper, grid reference 657736.

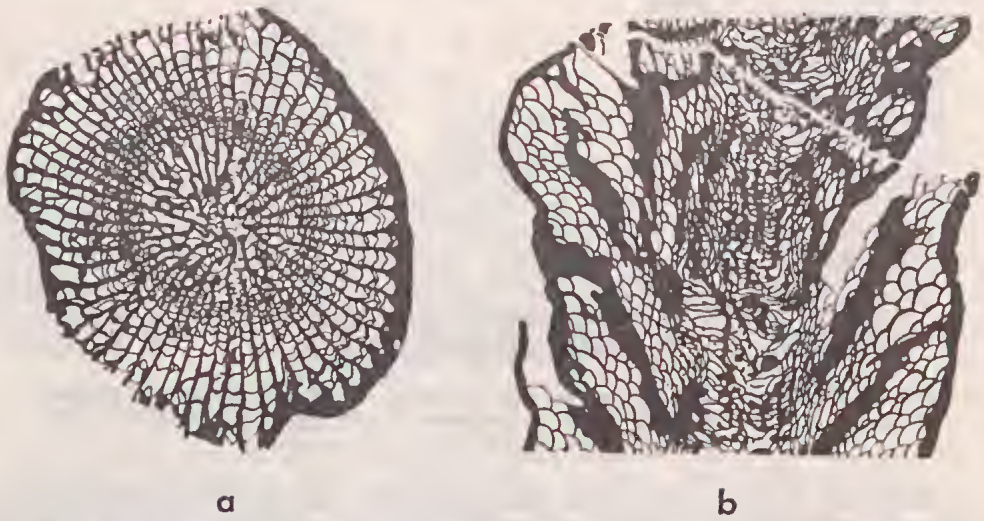

FIG. 11—*Embolophyllum aequiseptatum aequiseptatum* (Hill), × 3. (a) UNE F8920, hypotype, transverse section; (b) same specimen, longitudinal section. Cavan Limestone, Goodradigbee R., near Wee Jasper, N.S.W.

DIAGNOSIS: Dendroid corallum, increase both peripheral and lateral; mature corallites 16 to 23 mm in diameter. Calice deep, bell shaped. Septal bases expanded, wedge shaped in transverse section. Septa strongly flanged in tabularium and numbering 25 × 2 to 31 × 2 in adult corallites. Dissepiments numerous, steeply inclined at the periphery becoming even steeper towards the centre. Tabularium one-quarter to one-third as wide as the corallite; tabulae closely spaced, incomplete and in general, sloping towards the axis.

DESCRIPTION: Colony weakly dendroid, consisting of corallites, which are at first ceratoid to trochoid, and later subcylindrical with a mean diameter of 16 to 23 mm. Rejuvenescence frequent. Peripheral and lateral increase are demonstrable in hypotype UNE F8920; before sectioning it could be seen that the small corallites in fig. 4 of Pl. 5 are peripheral offsets from the larger corallite (now filled with a stromatoporoid); it could also be seen that the small corallite in fig. 7 of Pl. 5 is a lateral bud from the upper corallite of the same figure. Although not exposed in the present material, the calice is evidently deep and has the shape of an inverted bell.

The wall is probably fibrous inside the axial plate and in transverse section usually appears as a row of contiguous wedges; less commonly the septal bases, which are partly responsible for the wedges, are sufficiently expanded to form a narrow stereozone approximately 0·2 to 0·5 mm thick. Where the individual wedges join, the wall is about 0·2 to 0·5 mm thick; other parts, of course, are thicker. Septa radial, or just bilateral in arrangement and, apart from their peripheral expansion, are not especially dilated. Carinae are extremely fine and sporadic in the dissepimentarium, however in the tabularium the septa are strongly flanged and appear rhopaloid in transverse section. Major septa are unequal in length: some extend beyond the axis, others terminate 2 or 3 mm short of it. In contrast, the minor septa terminate uniformly near the inner margin of the dissepimentarium. The number of septa at given mean diameters is shown in Fig. 12. Although wavy when viewed in longitudinal section, the trabeculae are essentially parallel and directed inwards at angles of 10° to 45° to the horizontal.

The dissepimentarium is well developed, there being about 8 to 13 rows of dissepiments in adult corallites. Dissepiments are of moderate size and inclination throughout most of the dissepimentarium; however in the vicinity of the tabularium they are generally smaller and more steeply inclined.

Width of tabularium is one-quarter to one-third that of the corallite, except following a rejuvenescence when it is relatively greater. Tabulae are incomplete and normally slope towards the axis; as in other members of the family the marginal tabulae may be somewhat inflated.

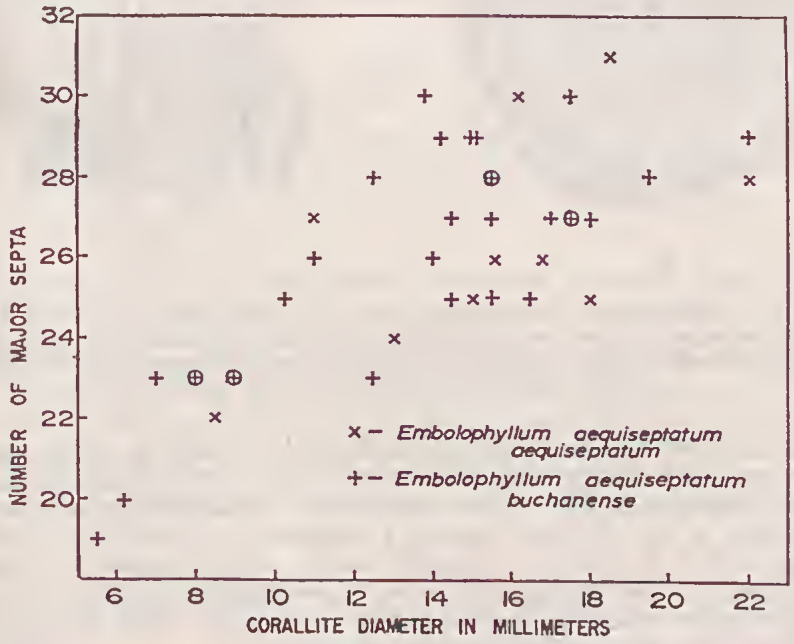

FIG. 12—*Embolophyllum aequiseptatum* (Hill). Scatter diagram of number major septa × diameter in 5 specimens of subspecies *aequiseptatum* from two localities near Wee Jasper, N.S.W. and 7 specimens of subspecies *buchanense* from a single locality (97 of Teichert and Talent 1958) near Buchan, Vict. Points derived from holotypes are encircled.

Embolophyllum aequiseptatum buchanense subsp. nov.

(Pl. 5, fig. 1, 3, 5; Pl. 6, fig. 1, 2, 5, 7; Fig. 12-13b)

1950 *Acanthophyllum aequiseptatum* Hill, Hill, p. 139, Pl. 5, fig. 1.
1950 *Acanthophyllum* sp., Hill, p. 139, Pl. 5, fig. 2.

NAME DERIVATION: Town of Buchan, Vict.

MATERIAL: The holotype, UNE F8923, and paratypes 1-6, UNE F8924-F8929 respectively, were collected by G. M. Philip and the writer from the Buchan Caves Limestone (late Siegenian or Emsian) on the road from Buchan to Orbost, Vict. (locality 96-98 of Teichert and Talent 1958).

The specimen, GSV 47765, figured by Hill as *Acanthophyllum aequiseptatum* is an exact topotype; others, GSV 47713, 47714, figured as *Acanthophyllum* sp., are from the same general area; all three were collected by Curt Teichert.

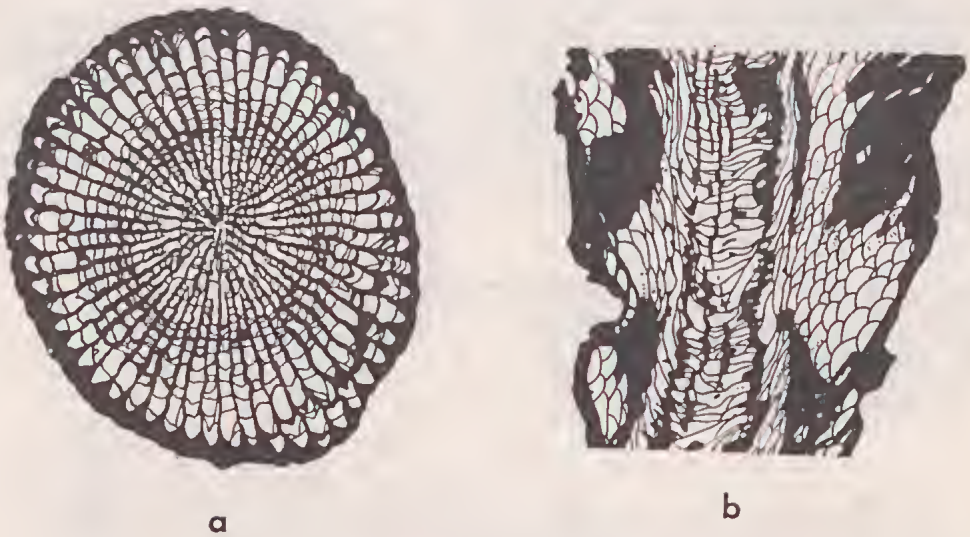

FIG. 13—*Embolophyllum aequiseptatum buchanense* subsp. nov., × 3. (a) UNE F8928, paratype 5, transverse section; (b) UNE F8925, paratype 2, longitudinal section. Both specimens are from the Buchan Caves Limestone at locality 97 of Teichert and Talent (1958) near Buchan, Vict.

DIAGNOSIS: Corallum dendroid to phaceloid; lateral budding known, peripheral budding suspected, but not proven. Adult corallites 13 to 22 mm in diameter. Calice deep, bell shaped. Septa prominently flanged in the tabularium and commonly strongly dilated at the periphery, forming a stereozone approximately 1 mm thick. Septal counts 25 × 2 to 30 × 2 per adult corallite. Septal grooves and interseptal ridges common, locally strongly developed. Dissepiments numerous, steeply inclined. Tabularium one-third to three-eighths of the total width of the corallite; tabulae closely spaced and inclined towards the centre.

REMARKS: The new subspecies is so similar to the nominate subspecies, fully described above, that a full description is not warranted. Compared with *E. aequiseptatum, sensu stricto*, the corallum is larger, more clearly colonial, and commonly phaceloid rather than dendroid; the average thickness of the wall is

greater and beceause it is locally deeply invaginated, may seem quite confluent with the septa; septal grooves and interseptal ridges, which may be entirely absent in the nominate subspecies, are more strongly developed; the innermost dissepiments tend to be coarser, there are however, exceptions to this; the width of the tabularium is between one-third and three-eighths of the total width of the corallite, whereas in *aequiseptatum, sensu stricto*, it is between one-quarter and one-third of the width of the corallite.

Embolophyllum mundum sp. nov.

(Pl. 7, fig. 1, 3)

1950 *Lyrielasma* aff. *floriforme* Hill, Hill *(partim)*, p. 140, Pl. 5, fig. 4.
non 1942b *Lyrielasma floriforme* Hill, p. 146, 147, Pl. 2, fig. 2.

NAME DERIVATION: L. *mundus* = neat.

MATERIAL: The holotype, UNE F8934, was collected by G. M. Philip and the writer in the Taravale Mudstone (Emsian) at the entrance to the Buchan Caves Reserve, Viet. A paratype, GSV 48129, was collected by Curt Teichert in 'lower Murrindal beds', one-half mile north of Buchan R. Bridge (locality 167 of Teichert and Talent 1958). This is the specimen figured by Hill and in terms of current nomenclature also came from the Taravale Mudstone.

The other coral, GSV 48460, identified by Hill as *Lyrielasma* aff. *floriforme*, is excluded from the new species; it was also collected by Teichert, but apparently from beds which would now form part of the Murrindal Limestone.

DIAGNOSIS: Corallum fasciculate, increase where observed peripheral; individual corallites ceratoid to subcylindrical with maximum diameter 16 mm. Sides of calice steep. Septa radially arranged, carinate, especially in the tabularium, and dilated at the periphery; cardinal septum long. Dissepiments variable, but generally inflated and about 5 or 6 deep. Tabularium with a marked axial depression.

DESCRIPTION: The paratype indicates that the corallum is fasciculate and demonstrates peripheral budding in the species; individual corallites are ceratoid to subcylindrical and have a maximum mean diameter of approximately 15 mm. The exterior is not exposed in the material at hand, but it may be assumed from sections that the calice is deeply funnel shaped.

Peripheral ends of the septa are expanded, so that in transverse section the wall resembles a series of wedges; thickness at the junction of these wedges is typically 0·5 to 0·7 mm. Although the cardinal and counter septa may be elongated, the arrangement of the septa is otherwise radial. Flanged carinae are particularly prominent in the tabularium, and the septa may also be slightly carinate in the dissepimentarium. Major septa variable in length: some only just penetrate the tabularium, whereas others extend to the axial region; minor septa are equally variable and typically about two-thirds to four-fifths as long as the major; normally they do not enter the tabularium. Septal counts with diameters expressed in mm are as follows:

Specimen	Status	Mean diameter	No. of Septa
GSV 48129	Paratype	6·0	18 × 2
GSV 48129	Paratype	12·0	22 × 2
GSV 48129	Paratype	14·0	28 × 2
UNE F8934	Holotype	15·5	29 × 2

Trabeculae are directed inwards at an angle of approximately 40° to the horizontal.

Dissepiments vary considerably in size and inclination; most however, are inflated and some are thickened by sclerenchymal investment; commonly 5 or 6 irregular rows are present.

The tabularium is one-third to three-fifths as wide as the corallite and consists of closely spaced incomplete tabulae. Typically these slope towards the axis and tend to be much broken up by the long flanged septa.

REMARKS: The author now has at his disposal a large number of specimens of *Lyrielasma floriforme* from the type area near Attunga, N.S.W. Compared with *Embolophyllum mundum*, these specimens have fewer septa (maximum 26 × 2 versus 29 × 2 in *E. mundum*), a much more pronounced peripheral stereozone (up to 3·5 mm thick), constituted partly of lamellar sclerenchyme, smoother septa, especially in the tabularium, and quite commonly a loose axial structure. The belief that the new species is geologically older than *L. floriforme*, further justifies the erection of a new species.

The corallite diameter and number of septa fall within the range of *Embolophyllum asper*; the two species are also of similar age. In *E. asper* however, the septa are finer, less carinate and locally withdrawn from the periphery.

Embolophyllum (?) mansfieldense (Dun 1898)

(Pl. 7, fig. 2, 6; Fig. 14-15)

1898 *Cyathophyllum mansfieldense* Dun, p. 87, 88, Pl. 3, fig. 3, 4.
1939 *Acanthophyllum mansfieldense* (Dun), Hill, p. 223, 224, Pl. 15, fig. 1-3.
1962 *Acanthophyllum mansfieldense* (Dun), Philip, p. 186, Pl. 26, fig. 11, 12.
1962 *Acanthophyllum mansfieldense* (Dun) ?, Philip, Pl. 26, fig. 9, 10.
? 1962 *Acanthophyllum sweeti* (Etheridge), Philip (*non* Etheridge), p. 187, Pl. 26, fig. 7, 8.
? 1964 *Acanthophyllum mansfieldense* (Dun), Spasskiy in Dubatolov and Spasskiy, p. 72.
non 1940a *Acanthophyllum* sp. cf. *mansfieldense* (Dun), Hill, p. 152, Pl. 2, fig. 1.
non 1942b *Acanthophyllum* ? *mansfieldense* (Dun), Hill, p. 146, Pl. 2, fig. 1.
non 1942c *Acanthophyllum* cf. *mansfieldense* (Dun), Hill, p. 182, Pl. 5, fig. 1.

MATERIAL: The holotype was collected by George Sweet from the Loyola Limestone (late Gedinnian or Siegenian) at Griffith's Quarry near Mansfield, Vict.; it may well be in the National Museum of Victoria, where much of Sweet's collection is stored, but at the present time has not been located.

7 or 8 topotypes are known. Two of these, UM TS608-TS610, were obtained by E. A. Ripper, the remainder, UNE F8881-F8884, F8930, F8931, by the writer. Of these, F8881-F8884 and F8931 are referred to a new variety name *fecundum*.

There are about 10 specimens from limestones in the Coopers Creek Formation (late Gedinnian or Siegenian) on Tyers R., Vict. The best of these are MU TS1594, TS1595 (locality 20 of Philip 1962, p. 125), TS1596, TS1597, TS1608, TS1610 (locality 3 of Philip), TS1606, TS1607 (locality 15 of Philip, figured as *A. sweeti*) and UNE F8932 (locality 15 of Philip). The last was collected by G. M. Philip and the writer, and the others by Philip alone.

REMARKS: The material recently collected at Loyola is distinctly separable into two varieties, and rather surprisingly the rarer of these conforms more closely with the descriptions of the species given by Dun (1898) and Hill (1939).

In stages preceding the attainment of a corallite diameter of 16 to 20 mm or so, septa are added at a rate such that the ratio between the width of septa and interseptal loculi is approximately constant. Subsequently the coral develops in one of two ways. In one, the corallite remains trochoid, and very few, if any, new septa are added while it enlarges to a maximum diameter of about 40 mm; the septa become dilated, usually periodically, and there may be local naotic tendencies. In

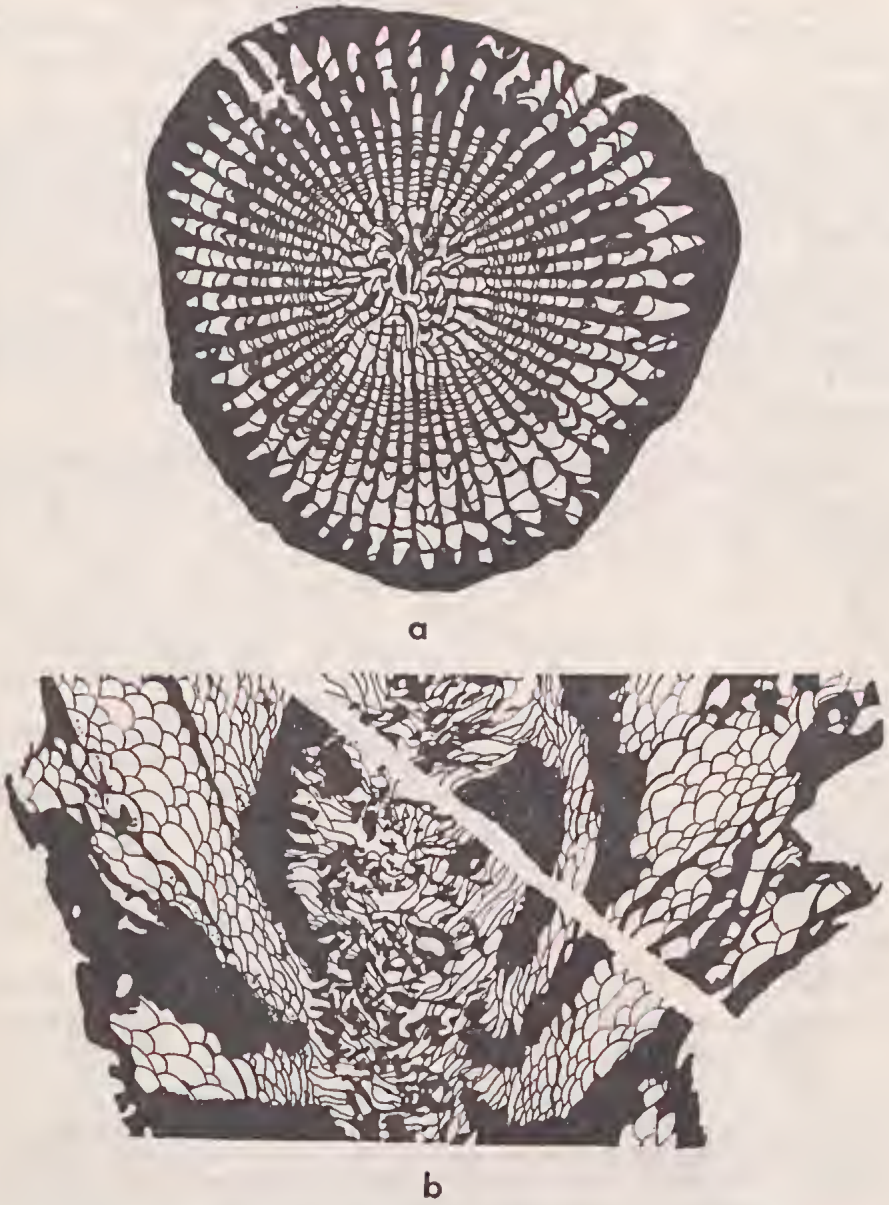

FIG. 14—*Embolophyllum* (?) *mansfieldense* (Dun), × 3. (a) UNE F8930, hypotype, transverse section; (b) same specimen, longitudinal section. Loyola Limestone at Griffith's Quarry near Mansfield, Vict.

the other kind of development, addition of septa continues as before, the corallites become subcylindrical and lateral offsets lead to the development of a fasciculate corallum.

Wedgewise dilation of the septa, which is apparent in Dun's figure of the holotype, is symptomatic of the first of the two types of development described above. Specimens of *E.* (?) *mansfieldense* exhibiting the second kind of development are referred below to a new variety named *fecundum.*

Hill (1940, 1942c) has compared a specimen from the Silverwood Series of S. Queensland and others from the Garra Beds of N.S.W. with this species. The presence of a peripheral platform and only 20 major septa at a diameter of 30 mm, excludes the Silverwood form from the species. The Garra specimens are presently under study by D. L. Strusz, who is tentatively placing them in a new species; the sole figure published to date is insufficient for identification.

Hill (1942b) has also doubtfully identified a specimen from the Tamworth Group with this species. In doing so she noted the strong septal dilation and the low number of septa in the Tamworth form. Now that the variation of *Embolophyllum* (?) *mansfieldense* is more fully understood, it is even less likely that the specimen is corectly identified with it.

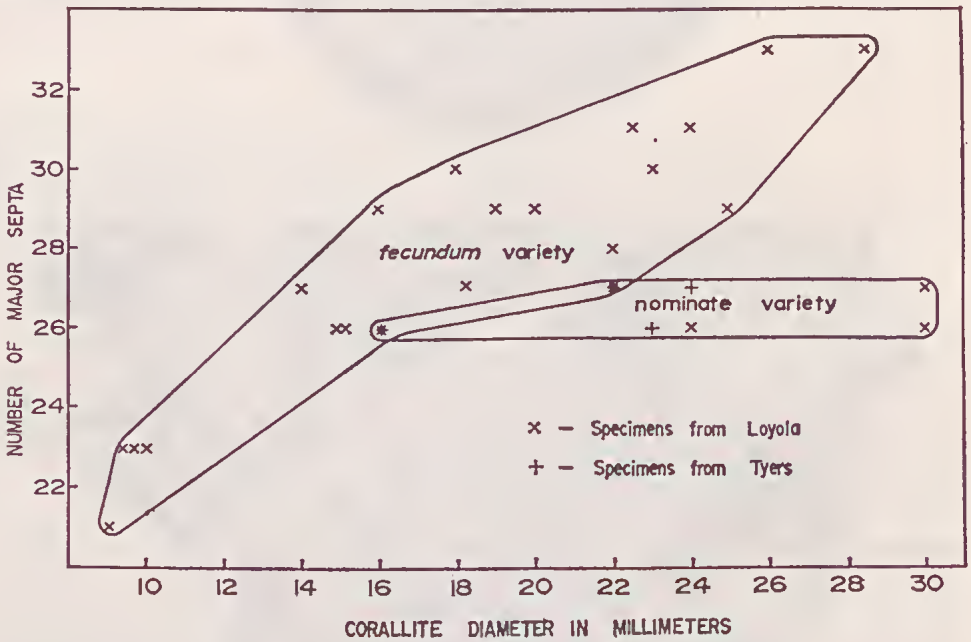

FIG. 15—*Embolophyllum* (?) *mansfieldense* (Dun). Scatter diagram of number of major septa × diameter in 6 specimens from the Loyola Limestone at Griffith's Quarry near Mansfield, Vict. and 4 specimens from a limestone in the Coopers Creek Formation on Tyers R., Vict.

Spasskiy (in Dubatolov and Spasskiy 1964) lists the species from the Lower Devonian of the Omulevskie Mountains in NE. Siberia; however the writer is not aware that this occurrence has been substantiated by published description or figures.

The generic identity of *Cyathophyllum mansfieldense* is discussed fully under the remarks on *Embolophyllum.*

Embolophyllum (?) mansfieldense var. **fecundum** nov.

(Pl. 7, fig. 4, 5, 7)

NAME DERIVATION: L. *fecundus* = fertile.

DIAGNOSIS: Corallum fasciculate, commonly phaeeloid; increase, where observed lateral; adult corallites 16·0 to 28·5 mm in mean diameter. Periphery essentially a septal stereozone. Calice deep, funnel shaped. Septa radial to weakly pinnate in arrangement, numbering 27 × 2 to 33 × 2 in mature corallites. Dissepiments typically elongate, 8 to 14 deep. Tabularium normal for genus, width one-quarter to one-third that of the entire corallite.

DESCRIPTION: Corallum large, more or less phaeeloid; lateral offsets occur, but at the moment there is no evidence of peripheral increase. Initially corallites are trochoid to ceratoid, and subsequently subcylindrical, with a typical mean adult diameter of 16·0 to 26·0 mm and a maximum of 28·5 mm. Sections indicate that the calice would be deeply funnel shaped.

Septa are radially arranged in some corallites, and in others are weakly pinnate about the cardinal-counter plane; at the periphery they are strongly dilated and usually contiguous forming a stereozone from 0·5 to 2·0 mm wide. Major septa flanged and commonly rhopaloid; in radially symmetrical corallites they extend to the axial region, but in bilaterally symmetrical ones, those close to the plane of symmetry may terminate well short of the axis. Minor septa only just project into the tabularium. Septal counts appear as a scatter diagram in Fig. 15. Trabeculae subparallel; inclination variable, maximum 45°.

Dissepiments typically elongate, steeply inclined and about 8 to 14 deep in a fully developed dissepimentarium.

Tabulae are closely spaced, incomplete and inclined towards the axis. The interior of the tabularium is poorly preserved, but appears to be dominated by septal ends and flanges. Width of the tabularium is one-quarter to one-third of the diameter of the corallite.

REMARKS: The closest previously described species is *Fasciphyllum isfajramense* Pavlova (1963, p. 42, 43, Pl. 6) from the Gedinnian of southern Ferghana. By comparison the new variety generally has fewer septa at a given diameter and finer dissepiments.

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Explanations of Plates

L.S. and T.S. are the abbreviations used throughout for longitudinal and transverse sections respectively

Plate 1

All figures × 3

Fig. 1-14—*Lyrielasma chapmani chapmani* nom. nov. (1) UNE F8877, hypotype; (2) UNE F8872, hypotype; (3) NMV P23009, hypotype; (4) UNE F8869, hypotype; (5) UNE F8864, hypotype; (6) NMV P23018, hypotype; (7) UNE F8862, hypotype; (8) UNE F8865, hypotype; (9) NMV P15970, holotype; (10) UNE F8863, hypotype; (11) UNE F8868, hypotype; (12) UNE F8860, hypotype; (13) NMV P15971, holotype; (14) NMV P23016, hypotype. All T.S. and from the Lilydale Limestone at Cave Hill, Lilydale, Viet.

Plate 2

Fig. 1-10, 12 × 3; Fig. 11, 13-15 × 2

Fig. 1-9—*Lyrielasma chapmani chapmani* nom. nov. (1) UNE F8872, hypotype, L.S.; (2) UNE F8877, hypotype, L.S.; (3) UNE F8870, hypotype, L.S.; (4) NMV P23009, hypotype, tangential section; (5) NMV P15972, holotype, L.S.; (6) UNE F8876, hypotype, L.S.; (7) NMV P15972, holotype, L.S.; (8) UNE F8871, hypotype, L.S.; (9) UNE F8860, hypotype, L.S. All from the Lilydale Limestone at Cave Hill, Lilydale, Viet.

Fig. 10, 12—*Lyrielasma* sp. nov., cf. *L. chapmani* nom. nov. (10) UNE 8933, hypotype, T.S.; (12) UNE F8933, hypotype L.S. Coopers Creek Formation, Coopers Creek, Viet.

Fig. 11, 13-15—*Embolophyllum asper* (Hill) gen. nov. (11) UNE F8911, hypotype; (13-15) UNE F8912, hypotype. All L.S. and from between 50 and 60 ft above the base of the Taemas Limestone, near Wee Jasper, N.S.W.

Plate 3

All figures × 2

Fig. 1, 2, 4, 5, 7, 8—*Embolophyllum aggregatum cracente* gen. et subsp. nov. (1) UNE F8905, paratype 1, T.S.; (2) UNE F8904, holotype, T.S.; (4) UNE F8904, holotype, L.S.; (5) UNE F8906, paratype 2, L.S.; (7) UNE F8907, paratype 3, L.S.; (8) UNE F8905, paratype 1, L.S. All from 443 to 448 ft above the base of the Taemas Limestone, near Wee Jasper, N.S.W.

Fig. 3—*Embolophyllum aggregatum aggregatum* (Hill) gen. nov. UNE F8886, hypotype. Between 588 and 638 ft above the base of the Taemas Limestone, near Wee Jasper, N.S.W.

Fig. 6, 9—*Embolophyllum asper* (Hill) gen. nov. (6) UNE F8911, hypotype, T.S.; (9) UNE F8914, hypotype, T.S. Both from 50 to 60 ft above the base of the Taemas Limestone, near Wee Jasper, N.S.W.

Plate 4

All figures × 2

Fig. 1, 6—*Embolophyllum asper* (Hill) gen. nov. (1) UNE F8912, hypotype, T.S.; (6) UNE F8911, hypotype, T.S. Both from 50 to 60 ft above the base of the Taemas Limestone, near Wee Jasper, N.S.W.

Fig. 2—*Embolophyllum aggregatum cracente* gen. et subsp. nov. UNE F8906, paratype 2, T.S. Between 443 and 448 ft above the base of the Taemas Limestone, near Wee Jasper, N.S.W.

Fig. 3-5, 7-9—*Embolophyllum aggregatum aggregatum* (Hill) gen. nov. (3-5) UNE F8898, hypotype, T.S.; (7) UNE F8885, hypotype, L.S.; (8) UNE F8899, hypotype, L.S. (9) UNE F8898, hypotype, L.S. F8898 and F8899 are from 523 to 528 ft above the base of the Taemas Limestone, and F8885 is from between 588 and 638 ft above the base of the same limestone; all are from the Wee Jasper area of N.S.W.

Plate 5

All figures × 2

Fig. 1, 3, 5—*Embolophyllum aequiseptatum buchanense* gen. et subsp. nov. (1) UNE F8928, paratype 5, T.S.; (3) UNE F8929, paratype 6, T.S.; (5) UNE F8923, holotype, T.S. All are from the Buchan Caves Limestone, near Buchan, Viet.

FIG. 2, 4, 6, 7—*Embolophyllum aequiseptatum aequiseptatum* (Hill) gen. nov. (2) UNE F8936, hypotype, T.S.; (4, 6, 7) UNE F8920, hypotype, T.S. Both from the Cavan Limestone, near Wee Jasper, N.S.W.

PLATE 6

All figures × 2

FIG. 1, 2, 5, 7—*Embolophyllum aequiseptatum buchanense* gen. et subsp. nov. (1) UNE F8924, paratype 1, L.S.; (2, 5) UNE F8929, paratype 6, L.S.; (7) UNE F8928, paratype 5, T.S. All from the Buchan Caves Limestone, near Buchan, Vict.

FIG. 3, 4, 6—*Embolophyllum aequiseptatum aequiseptatum* (Hill) gen. nov. (3, 6) UNE F8920, hypotype, L.S.; (4) F8935, hypotype, L.S. Both from the Cavan Limestone, near Wee Jasper, Vict.

PLATE 7

All figures × 2

FIG. 1, 3—*Embolophyllum mundum* gen. et sp. nov. (1) UNE F8934, holotype, T.S.; (3) UNE F8934, holotype, L.S. Taravale Mudstone, Buchan, Vict.

FIG. 2, 6—*Embolophyllum* (?) *mansfieldense* (Dun) gen. nov. (2) UNE F8932, hypotype, L.S.; (6) UNE F8932, hypotype, T.S. Coopers Creek Formation, Tyers R., Vict.

FIG. 4, 5, 7—*Embolophyllum* (?) *mansfieldense* var. *fecundum* nov. (4, 5) UNE F8881, hypotype regarded as type of the variety, L.S.; (7) UNE F8881, hypotype regarded as type of the variety, T.S. Loyola Limestone, near Mansfield, Vict.